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Four new species of *Ridsdalea* (Rubiaceae: Gardenieae) from Borneo, Wallacea and New Guinea

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Summary. Four new species of *Ridsdalea* are here described from Borneo, Wallacea and New Guinea. *Ridsdalea kassamensis* J.T.Pereira and *R. papuana* J.T.Pereira are endemic to Papua New Guinea; *R. puffiana* J.T.Pereira is endemic to Borneo and *R. sundaensis* J.T.Pereira is endemic to Sulawesi and the Lesser Sunda Islands. A key to the Malesian species of *Ridsdalea* is also included.

Rothmannia is typified by *Rothmannia capensis* from South Africa. Linnaeus in 1781 had transferred this species to the genus *Gardenia*, under the name *G. rothmannia* L.f. and following this, numerous conceptual changes have occurred, rendering *Rothmannia* species to be included within *Gardenia* s.l. or *Randia* s.l. Eventually, *Rothmannia* was accepted by most taxonomists as a distinct entity from the rest of the *Randia*-*Gardenia* complex but some generic limits were still arguable, as shown in Bremekamp (1957), Keay (1958), Wong (1984) and Bridson & Verdcourt (1988). Nearly all members of the *Rothmannia* complex, including in Asia and the SW Pacific, could be easily recognized in having sympodially developing branch units of two nodes which occur close together, in which one member of a leaf pair is vestigial, so that trifoliate leaf clusters result. Furthermore, the fruits are berry-like, indehiscent, medium to large (2–5 cm or more across), with many seeds immersed in a pulp-like tissue; all of which are distinctive characters shared by members of the group.

Pereira (2008) attempted to review the Asiatic (especially Malesian) taxa placed in or near *Rothmannia* against the type alliance and other species in Africa, by gathering comparative data based on morphology and fine structure. It was found that, among other features, the solely African type alliance of *Rothmannia* had truly solitary terminal flowers instead of a fundamentally cymose inflorescence. Wong & Pereira (2016) have considered various new

perspectives from molecular work that also demonstrate *Rothmannia* s.s. to be the group comprising the African type species and other species in Africa that have right-contorted corolla lobes. This group differs significantly from another African group with left-contorted corolla lobes, and even more fundamentally from the Asian members, all of which have left-contorted corolla lobes (Pereira 2008, Mouly et al. in prep.). Wong & Pereira (2016) demonstated that the Asian alliance had sufficient morphological disjunctions that allowed recognition of three genera, *Kochummenia* K.M.Wong, *Ridsdalea* J.T.Pereira & K.M.Wong, and *Singaporandia* K.M.Wong. Of these, the largest genus is *Ridsdalea*, into which 25 pre-existing names have now been recombined. Here I describe a new species of *Ridsdalea* from Borneo, another from Sulawesi and Flores islands (in the central Malesian region also known as Wallacea, in between the Sunda and Sahul continental shelves), and another two from New Guinea. With these, the known species of *Ridsdalea* now number 29, one of the largest tree genera of the Gardenieae subtribe in the Southeast Asian region.

THE MALESIAN SPECIES OF *RIDSDALEA*, INCLUDING FOUR NEW SPECIES

The four new species of *Ridsdalea* are distinguished from others so far known from Malesia in the following key. For species authorities other than taxa newly described here, refer to Wong & Pereira (2016).

KEY TO THE MALESIAN SPECIES OF *RIDSDALEA*

1a. Leaves (including young leaves of shoot tips) completely glabrous on both sides. Corolla tube glabrous both inside and outside [Papua New Guinea] ..... **2. *R. papuana***, sp. nov.

1b. Leaves in early stages always hairy (at least on the veins on lower side, or both sides). Corolla tube glabrous either on the inside or outside, never both,

2a. Stipules on leafy branches long, 10–23 mm long, apex (10–)15−20 mm long; inner surface of stipules with colleters in a central triangular area [Papua New Guinea] .... ***R. uvarioides***

2b. Stipules on leafy branches shorter, less than 10 mm long, apex shorter, less than 10 mm long; inner surface of stipules with colleters all over except at the distalmost portion,

3a. Calyx glabrous to scantily puberulous, the hairs if present, very minute and scattered (detectable only with × 10 magnification) on the surface,

4a. Corolla throat glabrous inside; lobes narrow, 0.25–0.3 cm wide [Philippines] .... ***R. lagunensis***

4b. Corolla throat hairy inside; lobes wider, 0.5–1.7 cm wide,

5a. Inflorescence a much-branched cyme, typically branching 2–3 orders, typically more than 5 flowers per cyme. Corolla tube short, 2–3.5 cm long, mouth narrow, 3.5–4 mm wide, base 1–1.5 mm wide [Sulawesi & Lesser Sunda Islands] ..... **4. *R. sundaensis***, sp. nov.

5b. Inflorescence unbranched or branched to at most 2 orders, typically up to 5 flowers per cyme. Corolla tube longer, 4–14.5 cm long, mouth wider, 5–20 mm wide, base wider, 2–5 mm wide,

6a. Leaf apex short- to long-acuminate. Corolla lobes 5. Calyx lobes 5. Anthers 5. Mature fruits large, 6–11.5 × 5–11 cm, pendulous; fruit wall 3–5 mm thick, very grainy [Borneo] ..... **3. *R. puffiana***, sp. nov.

6b. Leaf apex acute to obtuse. Corolla lobes typically 6–8, rarely 5. Calyx lobes typically 6–8, sometimes reaching 10, rarely 5. Anthers 6–10. Mature fruits smaller, 2.5–4.5(–5) × 2.5–4.5(–5) cm, erect; fruit wall thinner, 2–3 mm thick, not grainy [Borneo & Philippines] ..... ***R. merrillii***

3b. Calyx conspicuously (sparsely to densely pubescent) hairy on the surface, hairs *c.* 0.5 mm long, visible to the unaided eye,

7a. Flower pedicels long, (3–)5–15 mm long. Corolla campanulate with non-speckled throat. [Sulawesi] ..... ***R. forsteniana***

7b. Flower pedicels shorter, typically 0.5–2 mm long, rarely 3 mm long. Corolla hypocrateriform to campanulate; if campanulate, with speckled throat,

8a. Corolla campanulate. Style sparsely hairy [Myanmar, Thailand, Malay Peninsula, Sumatra, and Java] ..... ***R. schoemannii***

8b. Corolla hypocrateriform. Style glabrous,

9a. Corolla tube short, (0.6–)2–3(–3.5) cm long,

10a. Stipules short, 3–4.5 mm long, apex 0.5–1.3 mm long. Leaves thin- to thick-coriaceous. Corolla lobes hairy at the base on the inner surface. Corolla tube not distended at the upper half. Corolla throat with hairy zone covering part or all of the tube from the corolla mouth downwards [Papua New Guinea] ..... ***R. nigrescens***

10b. Stipules longer, 5–8 mm long, apex 2–6 mm long. Leaves chartaceous. Corolla lobes glabrous on the inner surface. Corolla tube distended at the upper half. Corolla throat glabrous [Philippines] .... ***R. graciliflora***

11a. Lamina (5–)6–8 cm broad; petiole 1.5–2 mm in diameter. Cymes much reduced or with only 1 order of distinct branching, 1–3 flowers per cyme. Calyx tube long, 9–11 mm long, outer surface hirsute with suberect hairs. Corolla lobes wide, 0.4–1 cm. Corolla mouth, 6–7.5 mm wide [Papua New Guinea] ..... **1. *R. kassamensis***, sp. nov.

11b. Lamina (8–)9–18 cm broad; petiole thicker, (2.5–)3–4 mm in diameter. Cymes distinctly branched to 2–5 orders, 11–130 flowers per cyme. Calyx tube shorter, 3–8 mm long, outer surface velvety-hairy to pubescent. Corolla lobes narrower, 0.1–0.4 cm. Corolla mouth only 2.5–3.5 mm wide,

12a. Stipule outer surface sparsely pubescent to glabrescent. Upper leaf surface glabrous. Inflorescence a very compact cyme with condensed branches, 2–3 distinct branching orders, rachis 0.5–1 cm long; primary branches along rachis 2–3 pairs, 0.1–0.2(–0.4) cm long. Peduncle short, 0.1–0.2 cm long, 4–5 mm thick. Bracts 4–6 mm long, sparsely pubescent. Calyx lobes (4–)6–10 mm long, pubescent. Fruits drying smooth [Papua New Guinea] .... ***R. macromera***

12b. Stipule outer surface velvety hairy. Upper leaf surface sparsely pubescent to glabrescent. Inflorescence a more laxly branched cyme, 3–4(–5) distinct branching orders, rachis 3–4 cm long; primary branches along rachis 3–4 pairs, 1–2.5 cm long. Peduncle longer, 0.5–2 cm long, 2.5–3.5 mm thick. Bracts 2–4 mm long, velvety hairy. Calyx lobes shorter, 0.5–1 mm long, densely tomnetose or velvety hairy. Fruits drying with minute flakes [New Guinea] ..... ***R. anisophylloides***

9b. Corolla tube longer, (3.5–)4–14.5 cm long,

13a. Corolla throat with hairy zone covering part or all of the tube from the corolla mouth downwards,

14a. Leaf apex cuspidate to caudate, to 1.5 cm long. Stipule apex short, to *c*. 0.5 mm long. Number of flowers 3–9. Calyx lobes typically 3–25 mm long, rarely 1 mm. Corolla lobes narrow, 0.6–1.4 cm wide [Sumatra, Peninsular Malaysia & Borneo] ..... ***R. grandis***

14b. Leaf apex acute to short- acuminate, to 0.3 cm long. Stipule apex longer, 1–2.5 mm long. Number of flowers fewer, 2–3. Calyx lobes shorter, 0.5–1 mm. Corolla lobes wider, (1.5–)1.8–2.5 cm wide [Philippines] ..... ***R. negrosensis***

13b. Corolla throat glabrous,

15a. Peduncle 0.2–0.4 cm long. Style and stigma 60–85 mm long, the stigma included but reaching just below or slightly above the corolla mouth and near or above the anthers [Philippines] ..... ***R. leytensis***

15b. Peduncle longer, 0.5–6.5 cm long. Style and stigma shorter, 15–50 mm long, the stigma included but reaching less than 2⁄3 way along the corolla tube and well below the anthers [Borneo] .... ***R. pseudoternifolia***

THE NEW SPECIES

In the specimen listings below, the abbreviations FLO, FRU and ST are used to indicate flowering and fruiting material, as well as 'sterile' material (without flowers or fruits), respectively. Also, Prov. indicates Province and months of the calendar year are abbreviated by their first three letters.

1. *Ridsdalea kassamensis* J.T.Pereira, **sp. nov.**

A species related to *R. macromera* (Lauterb. & K.Schum.) J.T.Pereira and *R. anisophylloides* (Wernham) J.T.Pereira, differing in having a narrower ((5–)6–8 cm) lamina; a thinner (1.5–2 mm) petiole; much reduced cymes with at most 1 order of distinct branching; only 1–3 flowers per cyme; longer (9–11 mm) calyx tube that has an outer surface with hirsute with suberect hairs; broader (0.4–1 mm) corolla lobes; and a corolla mouth 6–7.5 mm wide. (The other two species have broader ((8–)9–18 cm) lamina; a thicker ((2.5–)3–4 mm) petiole; cymes distinctly branched to 2–5 orders; 11–130 flowers per cyme; a shorter (3–8 mm) calyx tube that has a velvety-hairy outer surface; narrower (0.1– 0.4 mm) corolla lobes; and a corolla mouth only 2.5–3.5 mm wide.)

TYPE: *Brass 32331*, Papua New Guinea, Eastern Highlands Prov., Kassam Pass, 31 Oct 1959, FLO (holotype L).

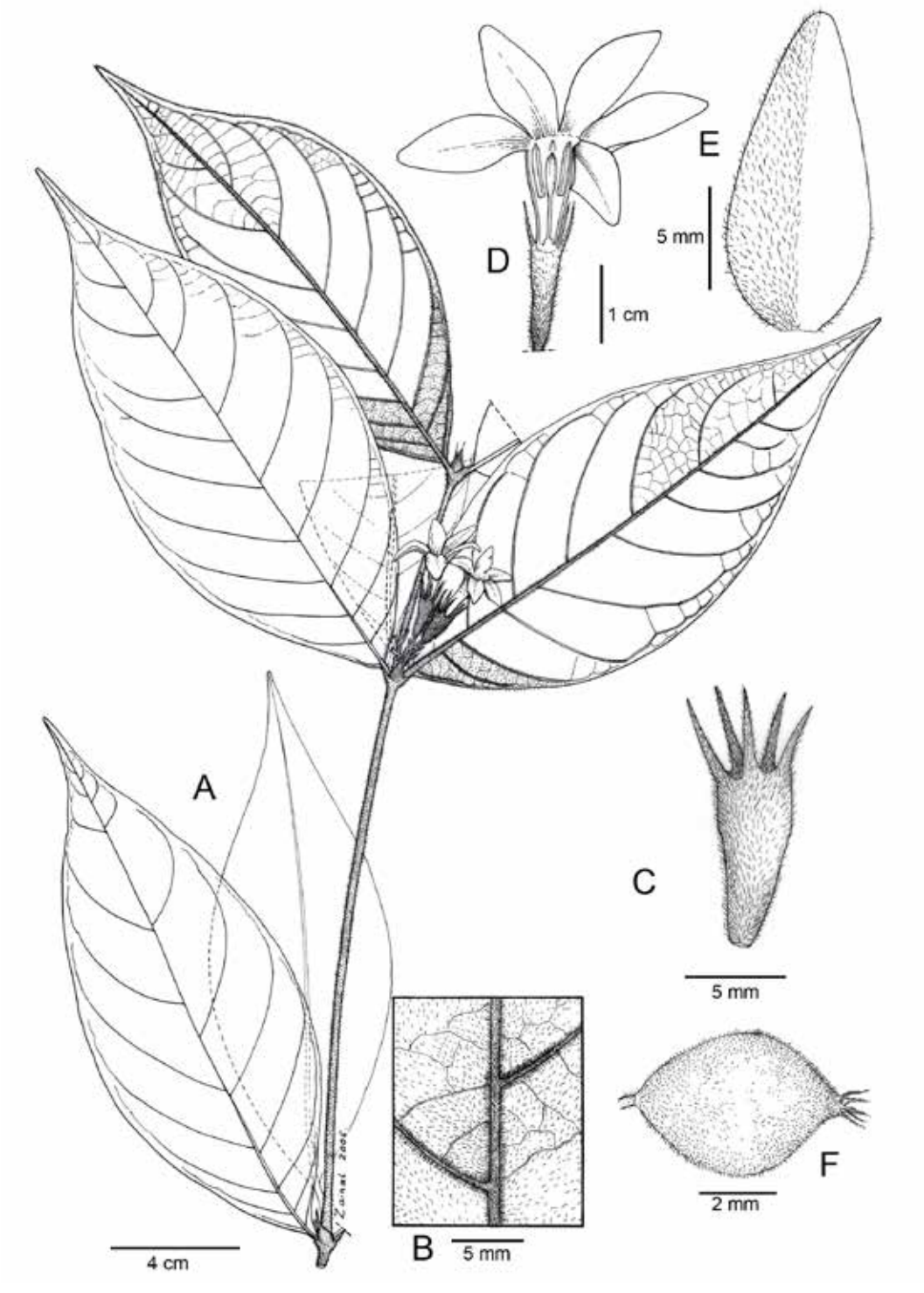

Fig. 1. *Ridsdalea kassamensis.* **A**. Leafy branch with inflorescences. **B**. Close-up of lower leaf surface with velvety hairs covering the midrib, secondary veins and entire surface. **C**. Calyx tube with long-linear lobes. **D**. Longitudinal section of flower. **E**. Outer surface of corolla lobe. **F**. Fruit. A–E from *Brass 32331* (holotype, L), F from *Forman LAE 60368 D* (BRI). (Drawing by Zainal Mustafa)

(Fig. 1)

Small tree, to 7 m high. Bark slightly peeling, blackish grey; inner bark wine red. Sapwood yellowish straw. Twigs velvety hairy when young, becoming sparsely pubescent when older. Branch leaves typically in groups of 3's, each trifoliate group based on a distal node with only one leaf normally developed (the other vestigial or very much reduced in size), and the proximal node with a pair of normal leaves. Stipules ovate-triangular, 4−6 mm long, 4−7 mm wide, outer surface sparsely pubescent, inner surface with colleters all over except at the distalmost portion; apex long-acuminate, 4−6 mm long. Young **leaves** on shoot tips velvety hairy on the lower surface, glabrescent on the upper surface. Mature leaves with petiole 0.2−0.3 cm long, 1.5−2 mm thick, pubescent to velvety hairy; lamina elliptic, lanceolate to oblanceolate, 14−18 cm long, (5−)6−8 cm wide, upper surface glabrous, lower surface velvety hairy; leaf base cuneate, symmetric to subrounded; leaf apex long-acuminate, acumen 1−2 cm long; thin-coriaceous to chartaceous when dry; midrib on upper side flat, glabrescent, on lower side raised, velvety hairy; secondary veins 6−9 pairs, on upper side flat to slightly sunken, glabrous, on lower side raised, velvety hairy; tertiary venation visible as a much-branched network between pairs of secondary veins. **Inflorescences:** peduncle 0.1−1 cm long, 1.5−2 mm thick, tomentose; habit compact, with 1 distinct branching order, rachis *c*. 0.5 cm long, primary branches along the rachis 1 pair, 0.15−0.3 cm long; bracts ovate 4–7 mm long, 4–5 mm wide, tomentose to pubescent. **Flowers** 1−3 per cyme; pedicels 2−3 mm long, *c.* 1 mm thick; calyx tube 9−11 mm long, 4−6 mm wide, hirsute, hairs erect, surface visible on the limb; calyx limb cup-shaped; calyx lobes 5, triangular at the base, becoming long-linear at the apex, 4−6 mm long, outer surface pubescent; corolla hypocrateriform, white to cream, the tube 1.5−2 cm long, 6−7.5 mm wide at the throat, 2−3 mm wide at the base; non-speckled inside, outer surface sparsely pubescent at the upper half, puberulous at the lower half, inner surface glabrous; corolla lobes 5, ovate-oblong to ovate, 1.4−1.8 cm long, 0.4−1 cm wide, outside pubescent on the uncovered half of the lobes, inside glabrous; anthers 5, fully included within the tube (inserted at the upper 1⁄3), 6−7 mm long; style and stigma 12−16 mm long, included but reaching just below the corolla mouth and the level of or above the anthers, style smooth, glabrous. **Fruits** ellipsoid, 4−5.5 cm long, 2.5−3.5 cm wide, velvety hairy, drying smooth; fruit wall 1−1.5 mm thick; peduncle *c*. 1 cm long, *c*. 1 mm thick. Mature seeds not seen.

ETYMOLOGY. It is named after the locality (Kassam Pass) of the type specimen.

DISTRIBUTION. Confined to the Eastern Highlands Prov. of Papua New Guinea (Fig. 2).

HABITAT**.** Found in *Castanopsis-Lithocarpus* forest, sometimes on ridges, to 1700 m alt.

SPECIMENS EXAMINED—PAPUA NEW GUINEA. Eastern Highlands Prov.: Kainantu subdistrict., Kassam Pass, *Brass 32331*, 31 Oct 1959, FLO (holotype L), 1400 m, *Forman LAE 60368D*, 25 Jun 1974, FRU (BRI, L), 4200ft [1280 m], *Vandenberg & Henty*

NGF 35004, 24 Jan 1968, FRU (BRI, L, SING), 5500ft [1676 m], *Streimann NGF 47892*, 11 July 1970, FRU (L).

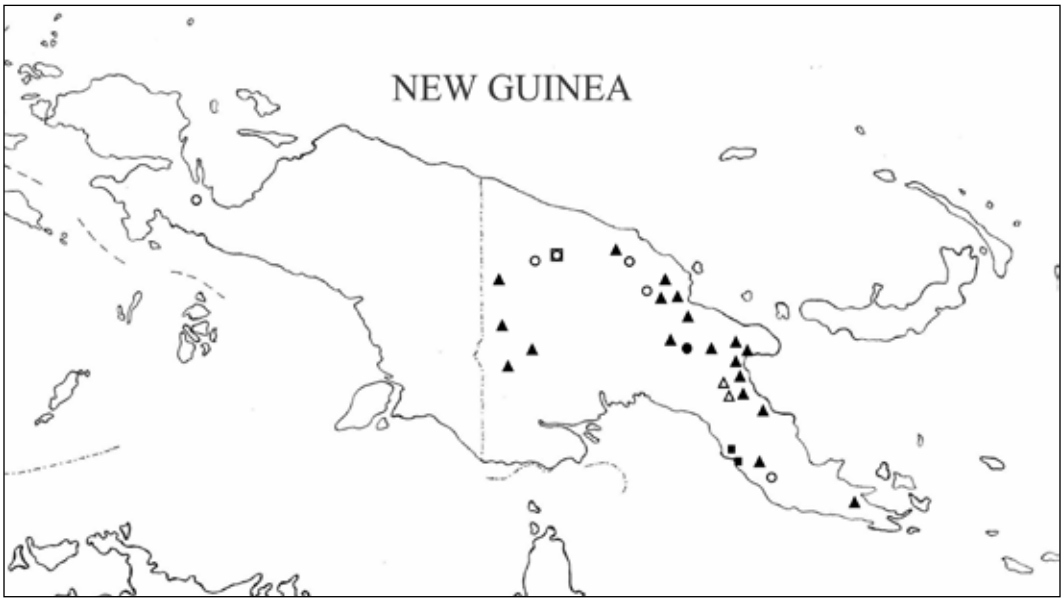

Fig. 2. Distribution of two new *Ridsdalea* species from New Guinea: *R. kassamensis* (solid circle) and *R. papuana* (solid squares). The distribution of *R. anisophylloides* (open circles), *R. macromera* (open triangles), *R. nigrescens* (solid triangles) and *R. uvarioides* (open square) is also depicted.

2. *Ridsdalea papuana* J.T.Pereira, **sp. nov.**

A species distinguished from all other Malesian species in having completely glabrous leaves on both sides (including young leaves of shoot tips) and a corolla tube that is glabrous both inside and outside. (The other species have hairy leaves, including in the early stages and a corolla tube that is glabrous either on the inside or outside, never both.)

TYPE: *Carr 11492*, Papua New Guinea, Central Prov., Lolorua, 24 Feb 1935, FLO (holotype A; isotypes BM, L).

(Fig. 3)

Tree, to 25 m high, to 45 cm diameter. Bark grey-brown; inner bark deep red. Sapwood olive green to light red. Twigs glabrous. Branch leaves typically in groups of 3's, each trifoliate group based on a distal node with only one leaf normally developed (the other vestigial or very much reduced in size), and the proximal node with a pair of normal leaves. **Stipules** broadly triangular, 5−9 mm long, 5−7 mm wide, outer surface glabrous; inner surface with

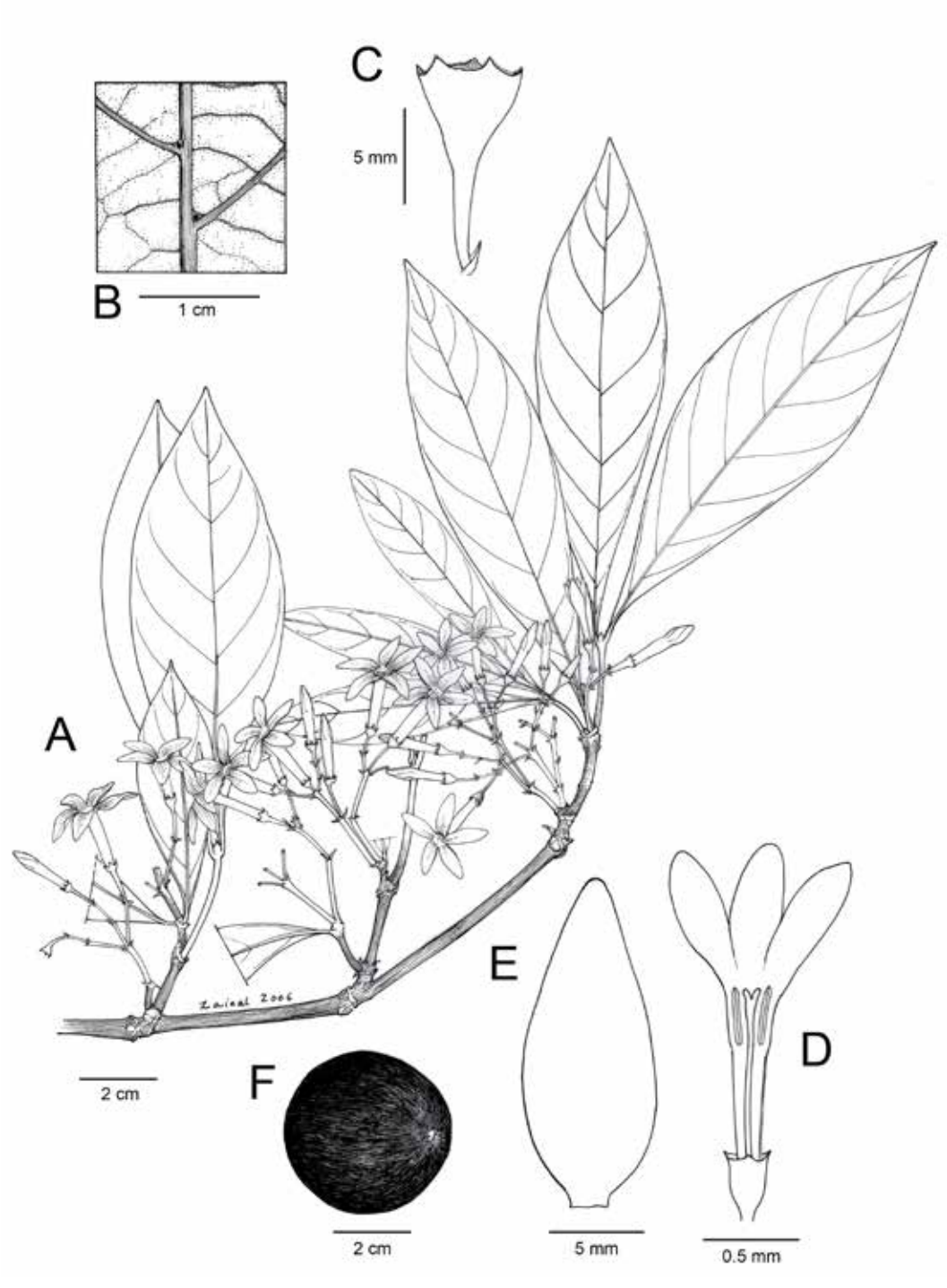

Fig. 3. *Ridsdalea papuana.* **A**. Leafy branch with inflorescences. **B**. Close-up of lower leaf surface showing domatia at the axils of the midrib and secondary veins. **C**. Glabrous calyx tube. **D**. Longitudinal section of flower. **E**. Outer surface of corolla lobe. **F**. Fruit. A–E from *Carr 11492* (holotype, A), F from *Streimann & Kairo LAE 51558* (BRI). (Drawing by Zainal Mustafa)

colleters all over except at the distalmost portion; apex acute to cuspidate, 1−3 mm long. Young **leaves** on shoot tips glabrous on both sides. Mature leaves with petiole 0.1−0.5 cm long, 1.5−2 mm thick, glabrous; lamina broadly elliptic, lanceolate to oblanceolate, 10−19 cm long, 5−7.5 cm wide, upper surface glabrous, lower surface glabrous; leaf base cuneate, sometimes attenuate; leaf apex acute, acumen 0.2−0.3 cm long; thin-coriaceous to chartaceous when dry; midrib on upper side flat, glabrous, on lower side raised, glabrous; secondary veins 6–9 pairs, on upper side flat, glabrous, on lower side raised, glabrous; tertiary venation visible as simple connections between pairs of secondary veins. **Inflorescences:** peduncle 0.1−1 cm long, 1.5−2 mm thick, glabrous; habit laxly arranged, with 3−4 distinct branching orders, rachis 3−3.5 cm long, primary branches along the rachis 1−2 pairs, 1–1.5 cm long; bracts short-triangular, 2−2.5 mm long, *c.* 2 mm wide, glabrous. **Flowers** 5−10 per cyme; pedicels 2−4 mm long, *c.* 1 mm thick; calyx tube 3−5 mm long, 3−5 mm wide, glabrous outside; calyx limb cup-shaped; calyx lobes 5, broadly short-triangular, 0.5−1 mm long, glabrous outside; corolla hypocrateriform, white, the tube 1−1.5 cm long, 4−5 mm wide at the throat, 2−2.5 cm wide at the base; non-speckled inside, outer surface glabrous, inner surface glabrous; corolla lobes 5, broadly elliptic to ovate, 1.2−1.5 cm long, 0.5−0.7 cm wide, outside and inside glabrous; anthers 5, fully included within the tube (inserted at the upper 1⁄3), 5–9 mm long; style and stigma 10−13 mm long, included but reaching just below the corolla mouth and the level of the anthers, style smooth, glabrous. **Fruits** globose, 3.5−4 cm long, 3−3.5 cm wide, glabrous, drying smooth; fruit wall *c.* 1 mm thick; peduncle *c.* 0.4 cm long, *c*. 5 mm thick. **Seeds** slightly to much flattened and broadly ovate or suborbicular to narrowly triangular, 6−7 mm long × 6−7 mm wide.

ETYMOLOGY. It is named after Papua New Guinea, from where it is thus far only known.

DISTRIBUTION. Confined to Papua New Guinea (Central Province only). Only known from three collections thus far (Fig. 2).

HABITAT. Recorded from seasonally dry evergreen rain forest, to c. 70 m alt.

SPECIMENS EXAMINED—PAPUA NEW GUINEA. Central Prov.: Lolorua, 100 ft [30 m], *Carr 11492*, 24 Feb 1935, FLO (holotype A; isotypes BM, L); Port Moresby subdistrict, Kuriva forestry area, near Veimauri River, 200ft [61 m], *Streimann & Kairo LAE 51558*, 6 May 1971, FRU (BRI, L, SING); near Port Moresby, 3 miles past Brown Bridge, 100ft [30 m], *White NGF 8262*, 4 May 1960, FRU (L, SING).

NOTES. In the type specimen, *Carr 11492*, which has flowers, the lateral branches of the ultimate vegetative node of a branch segment before terminal flowering are conspicuously elongated, 1–2 cm long. This character has not been observed in the fruiting specimens of this species or in the other Malesian species. Perhaps it is not a consistent feature. The species is distinct in having both sides of the leaves completely glabrous, even at the young shoot tips, and completely glabrous inflorescences.

3. *Ridsdalea puffiana* J.T.Pereira, **sp. nov.**

A species close to *R. merrillii* (Elmer) J.T.Pereira but differing in an acuminate leaf apex, five calyx and corolla lobes, pendulous large (6–11.5 × 5–11 cm) mature fruits with 3–5 mm thick, very grainy fruit wall. (*R. merrillii* has an acute to obtuse leaf apex, typically 6–8 (rarely 5) calyx and corolla lobes, erect smaller (2.5–4.5(–5) × 2.5–4.5(–5) cm) mature fruits with thinner (2–3 mm) non-grainy fruit wall.

TYPE: *Ridsdale PBU 396*, Indonesia, Kalimantan, Central Kalimantan, P.B.U. base camp and environs, side river of Rekut, riverside forest, 6 Jun 1990, FLO/FRU (holotype L; isotypes BO, K, KEP, SAN).

(Fig. 4)

Rothmannia sp. 1, Beaman & Anderson, The Plants of Mount Kinabalu (2004) 340.

Medium-sized tree, to 15 m high, to 15 cm diameter. Bark dark brown to dark grey; inner bark orange. Sapwood yellow. Twigs glabrous. Branch leaves typically in groups of 3's, each trifoliate group based on a distal node with only one leaf normally developed (the other vestigial or very much reduced in size), and the proximal node with a pair of normal leaves. **Stipules** shortly ovate-triangular, 1.5−4 mm long, 3−6 mm wide, outer surface glabrous, inner surface with colleters all over except at the distalmost portion; apex obtuse, acute to short-acuminate, to 1 mm long. Young **leaves** on shoot tips scantily pubescent on lower surface. Mature leaves with petiole (0.3−)0.5–1.5 cm long, 1−2 mm thick, glabrous; lamina obovate, elliptic to oblanceolate, 8−21−(26) cm long, 3.5−9(−13) cm wide, upper surface glabrous, lower surface glabrous to glabrescent; leaf base cuneate, attenuate, rounded to unequal; leaf apex short-to long-acuminate, acumen to 1.3 cm long; thin-coriaceous to chartaceous when dry, bullate on the upper leaf surface when fresh; midrib on upper side slightly raised, glabrous to glabrescent, on lower side raised, glabrous to sometimes pubescent; secondary veins 6−12 pairs, on upper side slightly raised, glabrous, on lower side raised, glabrous to scantily puberulous or pubescent; tertiary venation visible as simple connections between pairs of secondary veins or invisible. **Inflorescences:** peduncle 0.1−0.6 cm long, 1.5−3 mm thick, glabrous to glabrescent; habit compact, unbranched or with 1 distinct branching order, rachis 0.1−0.3 cm long, primary branches along the rachis 1 pair; 0.1−0.3 cm long; bracts ovate, 1.5−2 mm long, 2−3 mm wide, glabrous, hairy only at the margin. **Flowers** (1−)2−3 per cyme; pedicels *c*.1 mm long, 1−1.5 mm thick; calyx tube 6−12 mm long, 5−8 mm wide, glabrous to scantily puberulous, hairs appressed, surface visible, calyx limb cup-shaped; calyx lobes 5, short-triangular, 0.5−2 mm long, glabrous but scantily hairy at the margin; calyx limb cup-shaped; corolla hypocrateriform, white, the tube (8−)10.5−14.5 cm long, 6−9 mm wide at the throat, 2−3 mm wide at the base, non-speckled inside, outer surface glabrous to glabrescent, inner surface with hairy zone covering part or all of the tube from the rim of the corolla mouth downwards; corolla lobes 5, ovate-elliptic to lanceolate, 2.3−4.5 cm long,

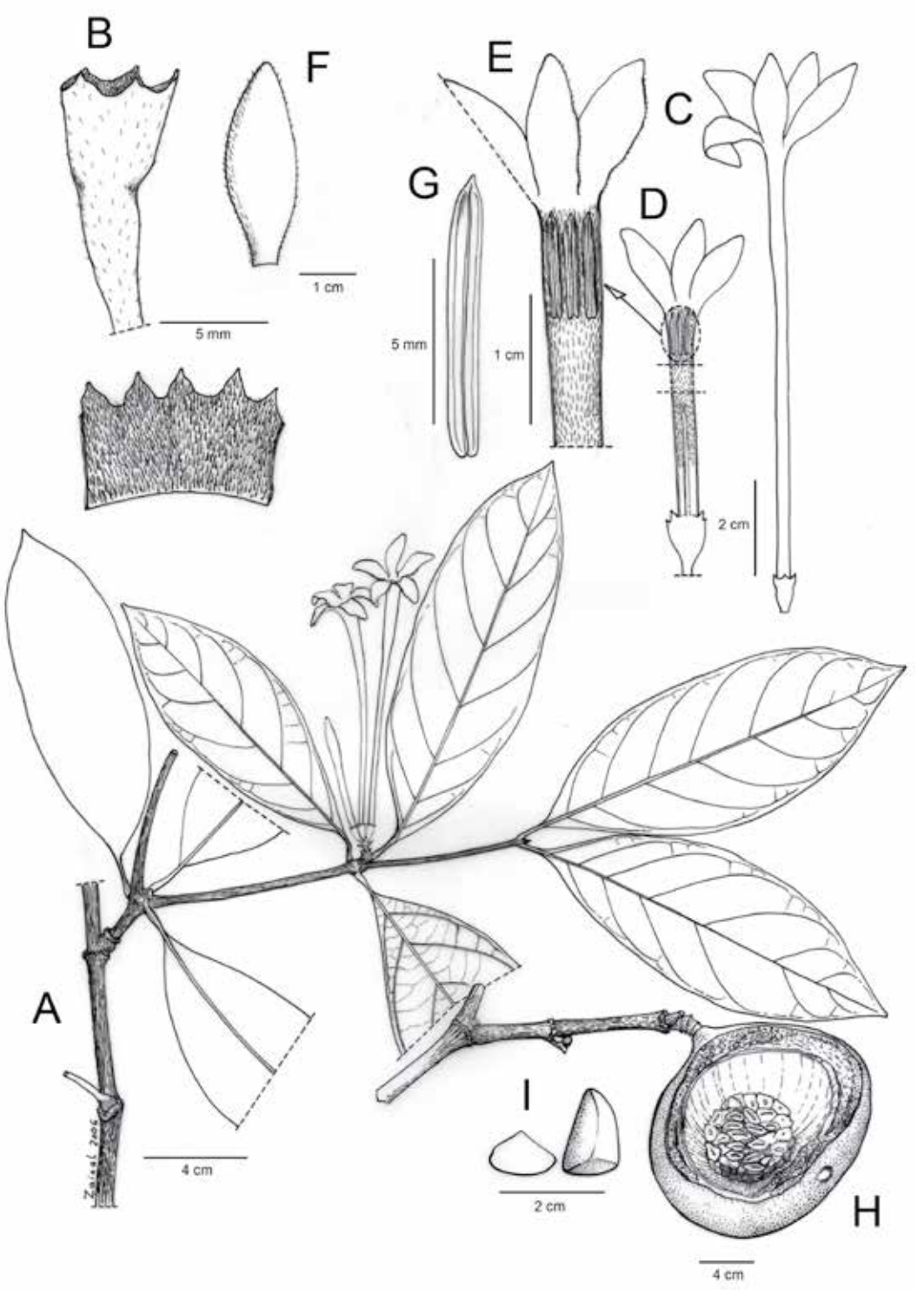

Fig. 4. *Ridsdalea puffiana.* **A**. Leafy branch with inflorescence. **B**. Scantily puberulous calyx tube. **C**. External aspect of flower. **D–E**. Longitudinal section of flower. **F**. Outer surface of corolla lobe. **G**. Anther. **H.** Fruit with seed mass. **I**. Seeds. A from *Ridsdale PBU 396* (holotype, L), B–G from *Clemens & Clemens 32201* (L), and H–I from *Carr* 27221 (SING). (Drawing by Zainal Mustafa)

0.6−1.7 cm wide, outside scantily puberulous at the margin or fringes of the lobes, inside glabrous; anthers 5, fully included within the tube (inserted at the upper 1⁄3), 6−12 mm long; style and stigma 60−80 mm long, included but reaching less than 2⁄3 way along the corolla tube and well below the level of the anthers, style smooth, glabrous. **Fruits** globose, 6−11.5 cm long, 5−11 cm wide, glabrous, drying smooth; fruit wall 3−5 mm thick, very grainy; peduncle 0.1−0.3 cm long, 5−11 mm thick. **Seeds** slightly to much flattened and broadly ovate or suborbicular to narrowly triangular, 10−14 mm × 8−10 mm.

ETYMOLOGY. This species is named in memory of the late Prof. Christian Puff, University of Vienna, Austria, a Rubiaceae specialist who carried out fieldwork in Sabah and who had been a wonderful mentor to the author.

VERNACULAR NAME. Sarawak: *Eloh sa'nieng* (Kelabit).

DISTRIBUTION. Endemic to Borneo (Sabah, Sarawak, Brunei and Kalimantan) (Fig. 6).

HABITAT. From lowland and hill forest to lower montane forest, frequently near rivers, to 1500 m alt.

Fig. 5. *Ridsdalea puffiana*: leafy branch with flower (left), fruit (upper right) and corollas (lower right). (Photo: J.T. Pereira)

SPECIMENS EXAMINED—BORNEO. SABAH. Kota Belud: Kg Kiau Nuluh, *Jusimin 369*, 22 Apr 1993, FRU (SNP), 695 m, *Pereira, Noorsiha et al. JTP 585*, 24 Feb 1999, ST (SAN); Kandasan, 10 miles W of Ranau, 3500 ft [1067 m], *Wood & Kapis SAN 16337*, 14 Dec 1955, FRU (BRI, L, SING). **Ranau:** Mile 37.5 [Km 60.3], Ranau Rd., *Mikil SAN 29250*, 23 Feb 1962, FRU (L, SAN, SAR), Ranau Rd., 4550 ft [1387 m], *Badak SAN 32341*, 10 Nov 1962, FLO/FRU (L, SAN); Mile 38 [Km 11.6], Ranau Rd., 4500 ft [1371 m], *Tai SAN 42535*, 14 Jan 1965, FRU (K, SAN, SNP); Sosopodon F.R., 1360 m, *Pereira et al. JTP 587*, 25 Feb 1999, ST (SAN); Tenompok: below Tenompok, 4700 ft [1432 m], *Carr 27221*, 3 May 1933, FRU (SING), *Clemens s.n.*, Mar 1932, FLO (BM), 5000 ft [1524 m], *Clemens & Clemens 28522*, 22 Feb 1932, ST (L), *Clemens & Clemens 28713*, Mar 1932, FLO (BM, K, L), *Clemens & Clemens 29661*, 10 May 1932, FRU (BO, K, L), *Clemens & Clemens 29661A*, Apr–May 1932, FLO (BO, K, L), *Pereira & Sugau JTP 591*, 26 Feb 1999, ST (SAN), 800 m, *de Wilde et al. SAN 142230*, 8 Dec 2003, ST (SAN); Dallas: 3000 ft [914 m], *Clemens & Clemens 26365*, 12 Sep 1931, FRU (K, L, SING), *Clemens & Clemens 27351*, 2 Dec 1932, FRU (K, L), *Clemens & Clemens 29251*, 11 Apr 1932, ST (BM, K, L), *Clemens & Clemens 29748*, 26 May 1932, ST (K, L), *Clemens & Clemens 30345*, 1931–32, ST (K); Mt Kinabalu: Ulu Langanani, 3800 ft [1158 m], *Chew, Corner & Stainton RSNB 1724*, 11 Aug 1961, FRU (BO, K, L, SAN, SING); Penibukan, Penibukan ridge, 4000 ft [1219 m], *Clemens & Clemens 51698*, Sep 1933, FRU (BM), Dahobong river, 3500 ft [1067 m], *Carr SFN 26382*, 5 Mar 1933, FRU (SING), 900 m, *Nooteboom & Aban 1510*, 10 Mar 1970, FLO (K, L, SAN), 4000–5000 ft [1219−1524 m], *Clemens & Clemens 31635*, 15 Feb 1935 FLO) (BO, K, L); 4000 ft [1219 m], *Clemens & Clemens 32201*, 17 Mar 1933, FLO/FRU (K, L), Penibukan ridge, 4000 ft [1219 m], *Clemens & Clemens 40494*, 28 Sep 1933, FLO (K, L). **Tambunan:** Crocker Range, Km 64, Kota Kinabalu–Tambunan Rd., 1250 m, *Beaman et al. 7318*, 30 Oct 1983, FLO (L); Mahua Waterfall, 400 m from the Reception Centre, 1099 m, *Jemson & Ubaldus SAN 152502*, 29 Aug 2010, FLO/FRU (SAN), trail to Mahua Falls, 1078 m, *Pereira et al. SAN 155114*, 20 Sep 2012, FLO (SAN, SNP, L), Mahua, Minduk Sirung trail from Mahua to Mt Alab, *Pereira et al. SAN 155116*, 20 Sep 2012, ST (SAN, SNP, L), *Pereira et al. SAN 155118*, 20 Sep 2012, FLO/FRU (SAN, SNP, L); Trusmadi, *Joseph et al. SAN 109441*, 20 May 1986, FRU (SAN); Mahua 1340 m, *Rimi et al. SP 19265*, 28 Aug 2003, FRU (SAN). **Sipitang:** Long

Fig. 6. Distribution of *Ridsdalea puffiana* (solid circles) in Borneo.

Pasia, *Postar & Davidson SAN 145771*, 3 Sep 2002, FLO (SAN). **BRUNEI. Temburong:** Amo, Kuala Belalong, Sg Belalong, 60 m, *Dransfield et al. JD 7077*, 15 Feb 1992, FRU (BRUN, K, SAN), Eastern slope of Bukit Bangar, 10–30 m, *Hotta 13095*, 19 Jan 1964, FRU (SAR). **SARAWAK. Sri Aman Div.** Lubok Antu: Sg Jelok, near Bukit Sengkajang, Lanjak-Entimau, 2100 ft [640 m], *Chai S 34038*, 18 Mar 1974, FRU (KEP, SAR). **Miri Div.** Miri: Sg Medalam, Gunung Mulu National Park, *Chai S 39473*, 13 Oct 1977, FLO/FRU (KEP, SAN, SAR); Sg Tinjar, Dulit Range, 860 m, *Dayang Awa & Yii S 46788*, 16 Oct 1983, FRU (KEP, L, SAN, SAR). **Limbang Div.** Limbang: Lawas, Kota F.R., Ulu Lawas, 800 ft [244 m], *Chai & Ilias S 31115*, 21 Oct 1971, FRU (SAR). **Kapit Div.** Kapit: Belaga, Rejang, *Haviland 2156*, Nov 1892, FLO (K, SING), Sg. Entulu, Sg Mengiong, near stream, *Lee S 54630*, 18 Aug 1987, FLO (SAR), Mujong, Temiai River, Hose mountain, submontane forest, 1260 m, *Lai, Jugah & Awang S 64099*, 6 Dec 1991, FRU (L, SAN, SAR); Baram, Kelabit Highland, at the foot of Apo Duat, 1300 m, *Sie S 35470*, 12 Nov 1974, FRU (SAN, SAR). **KALIMANTAN. E Kalimantan:** W Kutai, near Mt Kemoel, 1000 m, *Endert 3763*, 2 Oct 1925, FRU (BO, L), Central Kutei, Belajan River, Gunung Kelopok, near Tabang, 50 m, *Kostermans 10496*, 16 Apr 1955, FRU (A, K, L). **C Kalimantan:** P.B.U. base camp and environs, side river of Rekut, *Ridsdale PBU 396*, 6 Jun 1990, FLO/FRU (holotype L; isotypes BO, K, KEP, SAN).

NOTES. Vegetatively, this species is similar to *R. merrillii* but differs in the few characters mentioned in the key to Malesian species above.

4. *Ridsdalea sundaensis* J.T.Pereira, **sp. nov.**

TYPE: *van Balgooy 3946*, Indonesia, Sulawesi, between Soroako and Nickel Plant site, 500 m, 10 Jul 1979, FRU/FLO (holotype L).

Rothmannia merrilli sensu Kessler et al., Checklist of woody plants of Sulawesi, Indonesia, Blumea Supp. 14 (2002) 121, non (Elmer) J.T.Pereira.

(Fig. 7)

Small tree, to 15 m high, to 25 cm diameter. Twigs glabrescent when young, becoming glabrous when old. Branch leaves typically in groups of 3's, each trifoliate group based on a distal node with only one leaf normally developed (the other vestigial or very much reduced in size), and the proximal node with a pair of normal leaves. **Stipules** triangular to ovate, 2−3(−5) mm long, 4−5 mm wide, outer surface glabrous; inner surface with colleters all over except at the distalmost portion; apex obtuse, acute to cuspidate, to *c.* 1 mm long. Young **leaves** scantily pubescent on lower surface. Mature leaves with petiole 0.2−0.7(−1) cm long, 1−2 mm thick, glabrous; lamina elliptic, oblanceolate to obovate, (7−)9−16 cm long, (3−)4−9 cm wide, upper surface glabrous, sometimes shiny, lower surface glabrous;

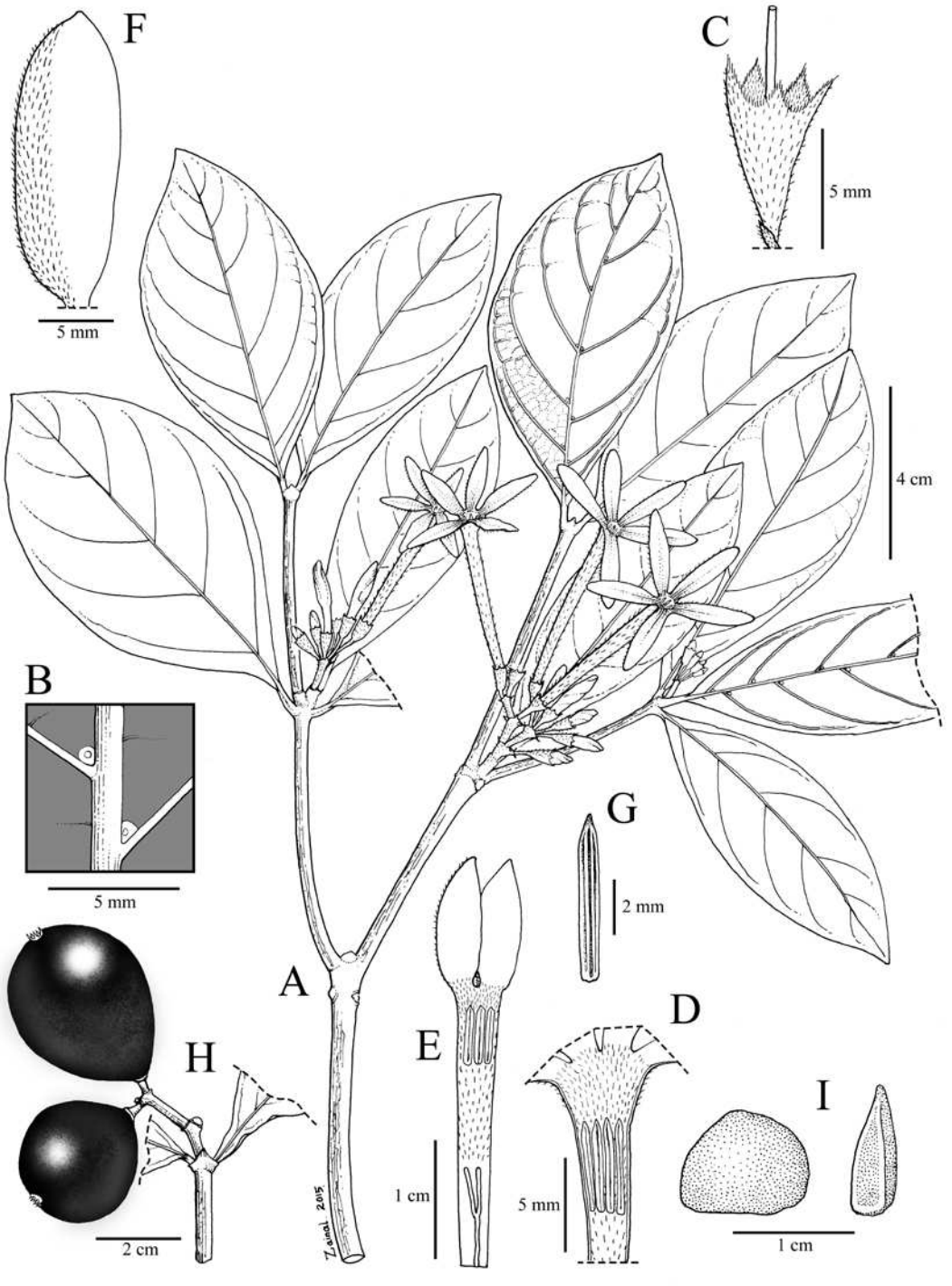

Fig. 7. *Ridsdalea sundaensis*. **A**. Leafy branch with inflorescences. **B**. Close-up of lower leaf surface showing pit-domatia in the axils of secondary veins along the midrib. **C**. Puberulous calyx tube. **D–E**. Longitudinal section of flower. **F**. Outer surface of corolla lobe. **G**. Anther. **H**. Infructescence. **I**. Seeds. A–G from *van Balgooy 3946* (holotype, L), H–I from *van Balgooy 4082* (L). (Drawing by Zainal Mustafa)

leaf base cuneate, attenuate to unequal; leaf apex acute to short-acuminate, acumen to 0.5 cm long; thin- to thick-coriaceous when dry; midrib on upper side flat, glabrous, on lower side raised, sparsely puberulous to glabrous; secondary veins 5−7(−8) pairs, on upper side flat, glabrous, on lower side raised, sparsely puberulous to glabrous; tertiary venation visible as simple connections between pairs of secondary veins. **Inflorescences:** peduncle 0.3−1.2 cm long, 2−2.5(−3) mm thick, glabrous; habit laxly arranged, with (1−)2−3 distinct branching orders, rachis 0.5−1.5 cm long, primary branches along the rachis (1−)2 pairs, 0.5−1 cm long; bracts narrowly ovate, 1−1.5 mm long, 1−1.5 mm wide, sparsely puberulous to pubescent at the apex. **Flowers** (4−)7−14 per cyme; pedicels obsolete to 1 mm long, *c*. 1 mm thick; calyx tube 4−6 mm long, 3.5−4 mm wide, glabrous throughout or puberulous at the limb and glabrous at the hypanthium, hairs appressed, surface visible; calyx limb cup-shaped; calyx lobes 5−6, short-triangular, 1−2 mm long, scantily puberulous to glabrous but sparsely puberulous on the margin; corolla hypocrateriform, white, the tube 2−3.5 cm long, 3.5−4 mm wide at the throat, 1−1.5 mm wide at the base; non-speckled inside, outer surface scantily puberulous, inner surface with hairy zone covering part or all of the tube from corolla mouth downwards; corolla lobes 5, elliptic to elliptic-oblong, 1.6−2(−2.5) cm long, 0.5−1 cm wide, outside scantily puberulous on the uncovered half of the lobes and near the margin, inside glabrous; anthers 5, fully included within the tube (inserted at the upper 1⁄3), 5−12 mm long; style and stigma 13−14 mm long, when included but reaching less than 2⁄3 way along the corolla tube, and well below the anthers but 30–35 mm long when partially exserted, style smooth, glabrous, stigma 10–17 mm long. **Fruits** globose to obovoid, 3.5−5 cm long, 2.5−4 cm wide, glabrous, drying smooth and sometimes shiny; fruit wall 1−1.5 mm thick; peduncle 0.5−1 cm long, *c*. 3 mm thick. **Seeds** slightly to much flattened and broadly ovate or suborbicular to narrowly triangular, 9−10 mm × 7−8 mm.

ETYMOLOGY. The species is named after Sunda Island, where the species is found.

DISTRIBUTION. Endemic to Sulawesi (Southeast, Central and South Provinces) and Lesser Sunda Islands (West Flores Island) (Fig. 8).

HABITAT. In primary and secondary forests, including heath forests, on sandy or ultrabasic soils, to 900 m alt.

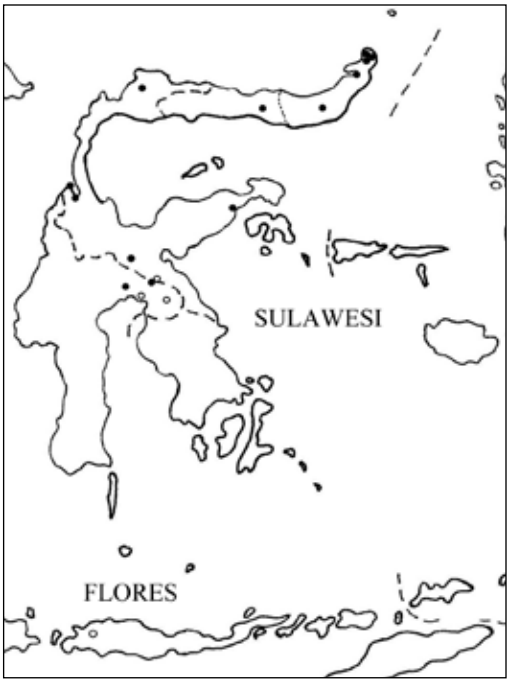

Fig. 8. Distribution of *Ridsdalea sundaensis* (open circles) in Sulawesi and Flores. The distribution of *R. forsteniana* is also shown (solid circles).

SPECIMENS EXAMINED—SULAWESI. No locality. *Bosekwezen s.n.*, 6 Jun 1925, FLO (BO). **Southeast Sulawesi Prov.:** Tawanggo, Kolaka, Mt Poli-polia, 200 m, *Prawiroatmadjo & Maskuri 1449*, 22 Oct 1978, FRU (SAR), around Opa swamp, W of Poli-polia, primary forest, 200–300 m, *Prawiroatmodjo & Soewoko 1919*, 23 Nov 1978, FRU (L). **South Sulawesi Prov.:** en Onderh. Ond. Afd. Malili Oesoe, 100 m, *Boschproefstation CEL II 338*, 4 Apr 1931, FRU (L), Malili, *Boschwezen bb 1925*, s. datum, ST (BO), Oesoe, 100 m, *Maturandong 113*, 2 Oct 1931, FRU (BO), 100 m, *Neth. Ind. For. Service CEL II 306*, 10 Feb 1931, FLO/FRU (BO, L, SING), 200 m, *Neth. Ind. For. Service CEL II 395*, 10 Apr 1934, ST (L); Soroako road, 150 m, *Balgooy 3894*, 6 Jul 1979, FLO & FRU (L); between Soroako and Nickel Plant site, 500 m, *Balgooy 3946*, 10 Jul 1979, FRU/FLO, (holotype L); Batu Besi between Tabarano and Larona river, 300 m, *Balgooy 4082*, 19 Jul 1979, FLO/FRU (L). **Central Sulawesi Prov.:** west part of Batudaka Island, Kayome, *Sidiyasa et al. 1885*, 25 Dec 1999, FRU (BO). **LESSER SUNDA ISLANDS. Flores:** *Schmutz 3606*, 26 May 1905, FRU (L); Manggarai, 300 m, *Schmutz SVD 4017*, 28 Jan 1978, FRU (L), Naga, 900 m, *Schmutz SVD 4121*, 6 May 1978, FLO (L), 450 m, *Schmutz SVD 4781a*, 25 Feb 1981, ST (L).

NOTES. This is a species close to *R. merrillii,* with which it is probably vicariant. Many of the Celebes specimens had been misidentified as *R. merrillii*. However, this species is distinguishable from *R. merrillii* in having typically more flowers per cyme (7–14, rarely as few as 4) whereas *R. merrillii* typically has 3–5 flower per cyme, rarely reaching 9 flowers per cyme; in its peduncles that are 0.5–1 cm long (peduncles to 0.3 cm long in *R. merrillii*); the generally shorter corolla tube, to only 3.5–4 cm long (3.5–7.5(–12) cm long in *R. merrillii*); narrower corolla mouth, 3.5–4 mm wide (5–9 mm wide in *R. merrillii*); narrower corolla tube base, only 1–1.5 mm wide (2–3 mm wide in *R. merrillii*); and 5 anthers (6–10 in *R. merrillii*).

There is a collection, *Schmutz SVD 4121*, that has flowers with style and stigma partially exserted from the corolla mouth. The rest of the specimens have shorter styles, i.e., included and reaching less than 2⁄3 way along the corolla tube and well below the anthers. A heterostylous condition may occur in this species, but more material and observations are needed to substantiate this.

A fruiting collection, *Sidiyasa & Didi 1885*, is very close to this species but differs in having larger mature leaves, 20−25 × 10−12 cm, whereas the typical *R. sundaensis* has smaller leaves, (7−)9−16 × (3−)4−9 cm.

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